MICROSCOPY.[1]

Caldwell's Automatic Microtome.[2]—This machine has been devised to save labor to the histologist by cutting a very great number of sections suitable for microscopic investigation in a very short time. The machine is worked by hand and may easily be made to deliver in one continuous band, accurately cut sections at the rate of 100 per minute. To use it, however, to the best advantage, it is well to drive it by means of some motor, the fly-wheel being already provided with a groove for the reception of the cord coming from the motor. Where there is sufficient pressure and supply of water, a simple form of water motor seems the most appropriate and least expensive.

Method of using the Microtome.—Place one of the cylindrical vessels supplied with the machine upon a piece of paper on a glass plate, and pour into it sufficient melted paraffine to fill it. As this cools the paraffine will contract, and will leave a hole, which must be filled up with more melted paraffine.

Melt a small quantity, say an ounce, of imbedding material in some suitable vessel; a small copper pan or a porcelain crucible answers very well, if care is taken not to allow it to become hotter than is sufficient to thoroughly melt it. Take a piece of glass and smear it with a very small quantity of glycerine, to prevent the imbedding material from sticking to it. Then pour the melted material on the glass in small quantities at a time, so as to get a layer nearly a quarter of an inch thick. This when cut up into suitable pieces with a knife does very well for imbedding small objects. If larger objects are required, it is well to have two pieces of brass of the form shewn in Fig. 5, which, when placed together, will form a cavity half an inch in depth and of any desired length up to an inch or more; this cavity may be filled with the melted material in the manner already described, and the object to be cut must then be placed in position while the material is fluid. *It is well to cool the material as rapidly as possible by placing it in water as soon as it is sufficiently set.* From the cake thus formed, or from the piece cast in the mold, cut the piece of the material containing the object, and with an old scalpel, heated in a Bunsen flame, melt a small hole in the paraffine contained in the cylindrical vessel (Fig. 1 *a*), and insert the piece of imbedding material containing the imbedded object; then with the heated scalpel melt a little of the paraffine round the base of the projecting piece, so as to give it firm support, and allow this to become thoroughly set.

Now remove the large brass plate from the top of the microtome (Fig. 1 *b*) and insert the vessel containing the imbedded object in the tube for its reception, having first oiled the tube

[1] Edited by Dr. C. O. Whitman, Mus. Comparative Zoology, Cambridge, Mass.

[2] *Quart. Jour. Micr. Sc.*, xxiv, Oct., 1884, p. 648.

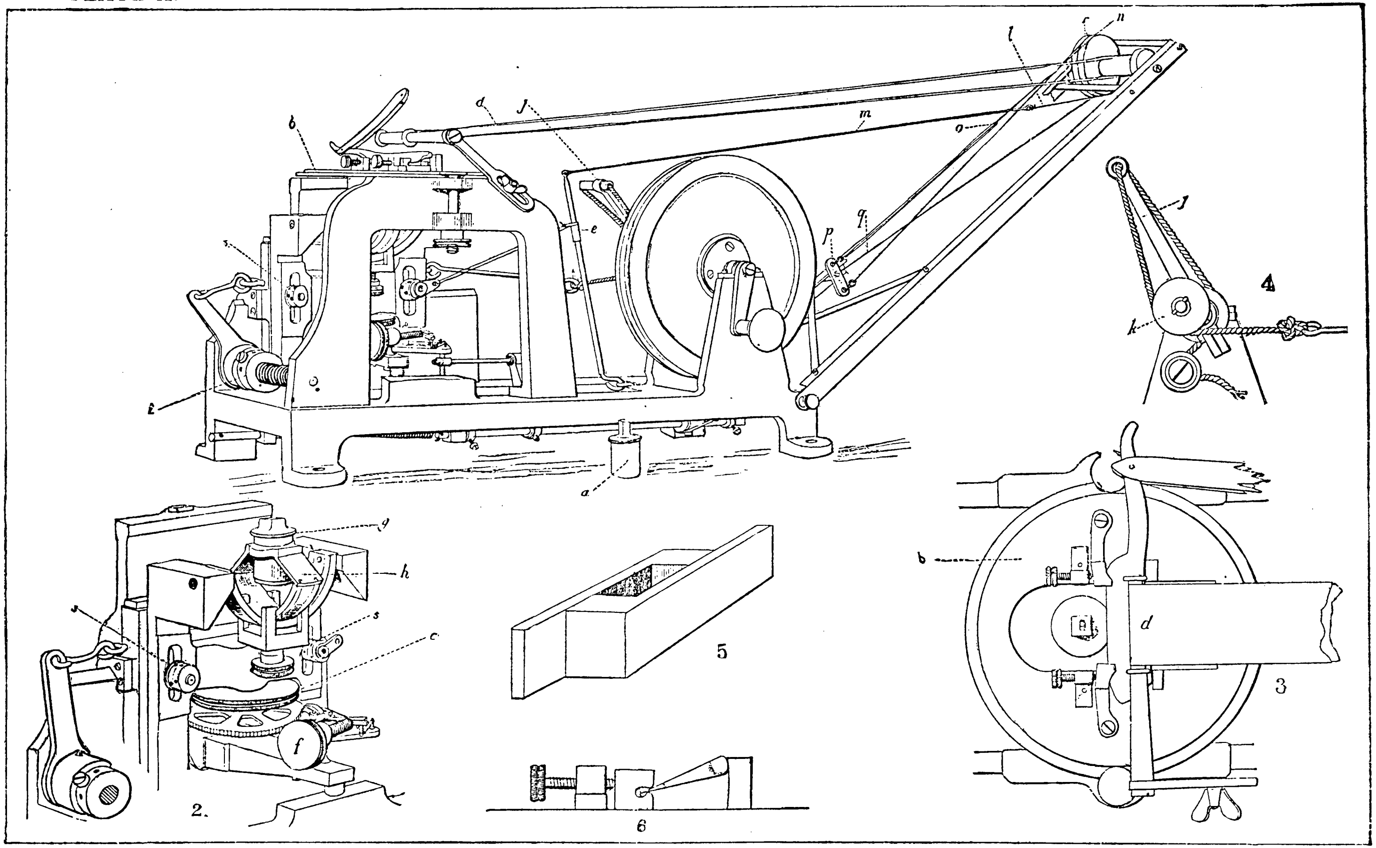
slightly to prevent the vessel from sticking. Next with a sharp knife *cut the material with the object imbedded in it, so that all its opposite sides are parallel.* This is extremely important. Replace the top plate and fix the razor in the holder provided for the purpose. The clamp is so made that if a little care is taken the edge of the razor will not be injured (Fig. 6). The razor must be set so that its back is as high as possible, as shewn in Fig. 6, and above all *the razor must be extremely sharp. It should be sharpened on a stone and not on a strop.* The sharpness of the razor and the accurate parallelism of the sides of the mass to be cut are the most important points in the whole process.[1] Underneath the frame containing the object is a large brass milled head (Fig. 2 *c*). By turning this the object may be raised or lowered according to the direction in which it is turned. This should be done until the object is just below the edge of the razor. The plate holding the razor should then be moved so that the edge of the razor is close to and quite parallel with the mass of material to be cut[2] (Fig. 3). The plate should then be clamped by the screws at each side of it. A few turns of the fly-wheel will now bring the razor in contact with the object to be cut. The band of black ribbon (Figs. 1 and 3 *d*) is now to be placed so that the end of it should be just above the razor and clamped in that position. When the handle is turned the sections should come off the razor in the form of a ribbon.

The ribbon of sections will not find its way to the continuous black band without assistance. With a needle in a handle or with the point of a scalpel pick up the end of the ribbon, when a sufficient length of it has been cut, and place it on the black continuous band, up which it will travel. When it reaches the top of the band suitable lengths may be cut off with a pair of scissors. It may be found that the black band travels either too slowly or too fast. Its speed may be varied by moving the ring (Fig. 1 *e*) up or down upon the vertical brass arm—upwards if it is moving too fast, downwards if too slow. A frequent cause of failure in the proper movement of the band is, that the ebonite roller at the bottom of it is allowed to press against the razor; this must be avoided.

[1] The makers of the instrument have nearly completed an automatic machine for sharpening razors, since it has occurred to them that this is an operation which may be performed with much greater accuracy by mechanical means than by hand.

[2] The distance through which the sliding stage moves can be altered by raising or lowering the arm (Figs. 1 and 4 *j*). This distance should be so arranged that the surface of the imbedding mass containing the object to be cut just clears the razor when the sliding carriage is at its maximum and minimum distance from either end of the machine. This is important as the speed with which the black band travels varies directly with the throw of the machine. If this adjustment is made and a little care is used in adjusting the ring (Fig. 1 *e*), see below, the ribbon will move at each turn of the fly-wheel through a distance equal to the breadth of the surface which is being cut. If, on the other hand, the object swings far beyond the razor, the band will travel too quickly and probably break the string of sections.

PLATE X.



Caldwell's Automatic Microtome.

Varying the thickness of the sections.—In Fig. 2 will be seen a milled head, *f*, which, when turned, controls the movement of the clicks which, acting upon the ratchet wheel attached to the micrometer screw, regulate the thickness of the sections. This may be done so as to allow the clicks to engage one-half, one or several teeth of the ratchet wheel as may be required. When arranged for one half tooth, the sections will be $\frac{1}{10000}$ of an inch (.0025^{mm}) in thickness, when arranged to engage a whole tooth $\frac{1}{5000}$ of an inch (.005^{mm}) and so on. At first it is well to use a whole tooth, as when thinner sections are cut so much depends on the sharpness of the razor. After cutting for some time the machine will suddenly stop, the object ceasing to rise when the handle is turned. This means that the full extent of the micrometer screw has been reached. It is necessary then to turn the large milled head (Fig. 2 *c*) downwards, which will allow the carriage containing the object to fall to its lowest limit. It will be necessary now to raise the socket (Fig. 2 *g*) in which the object is held so as to be in position to come in contact with the razor. This milled head (Fig. 2 *c*) is useful for rapidly getting the object in proper position and avoiding considerable loss of time in turning the handle. The frame (Fig. 2 *h*) which holds the socket is arranged with two quadrants, so that the socket may be set at any angle desired, and may be clamped with the milled head underneath it. This is for use when the object has not been symmetrically imbedded. The nut (Fig. 1 *i*) is for tightening up the spring which draws the carriage of the machine back after having been pulled forward. In case this does not work properly, it is only necessary to unloose the two screws and with some strong but blunt pieces of steel placed in the two holes, to rotate the nut so as to give a proper tension to the spiral spring. When this is done the screws should be tightened up again to keep the nut in place.

The lock nuts (Figs. 1 and 2 *s*) should be screwed up sufficiently tight to barely prevent the carriage from falling by its own weight, so that when the milled head (Fig. 2 *c*) is screwed down a slight pressure with the finger is necessary to make the carriage fall.

To arrange the machine for cutting different sized blocks of material, it is only necessary to raise or lower the arm (Figs. 1 and 4 *j*). When this arm is in a vertical position the machine is arranged for its maximum traverse. When turned to the right and placed horizontally it is at its minimum traverse. The cord, however, must always be in the groove of the wheel, *k*.

It is important to keep the strings which give motion to the endless band in proper position. The string (Fig. 1 *l*) should go from the end of the wire, *m*, round the groove, *n*, in the pulley and thence to the elastic band, *o*. The elastic band, *o*, should be stretched and placed over the hook attached to the arm, *p*, care

being taken that the shorter end of the arm, p, is uppermost. The string, q, should be tied to the stud upon which the arm, p, is supported, going thence round the groove, r, of the pulley, and back again to the hook at the longer and lower end of the arm, p, to which it should be tied.

Method of preparing the slide.—Make by the aid of heat a viscid solution of white shellac in light colored creosote. Spread a smooth, thin and even layer of this solution on a clean dry slide with a camel hair brush or with the little finger. Arrange the ribbon containing the sections on this slide while moist, and place it in the dry shelf of the water bath, which should be at a temperature slightly above the melting point of the imbedding material used. It should be left here until the creosote has evaporated and the imbedding material melted. Now allow the slide to cool, and then wash it with turpentine until all the imbedding material is dissolved. Canada balsam in chloroform or turpentine and the cover slip may now be applied in the usual manner. For convenience of mounting it is extremely important that the ribbon of sections should be quite straight, and in order to ensure this it is necessary that the sides of the imbedding material from which the sections are cut should be quite parallel. The straight ribbon, when obtained, should be removed to some clean surface and there cut into lengths appropriate to the size of the cover slips used. It will be found convenient to use cover slips at least two inches long; indeed, a useful length for slides and cover slips is six inches for the former and four inches for the latter.

A method of imbedding the specimen to be cut.—After the specimen has been stained it should be left in ninety per cent alcohol for a few minutes, and thence transferred to absolute alcohol, there to remain until all the water is extracted. The length of time necessary for this varies greatly with the size of the specimen. A three day chick, for instance, will require about an hour, larger specimens a day or more, in which case the absolute alcohol should be changed occasionally. Some tissues may be transferred directly from the absolute alcohol to turpentine, and thence in about two hours to the melted imbedding material. For delicate tissues, however, the following process, though longer and more troublesome, is greatly preferable. With a pipette introduce some chloroform to which two or three drops of ether have been added, under the alcohol in which the object is lying. The object will then float for some time at the junction of the alcohol and chloroform, and will finally sink into the chloroform when saturated with it. If, as often happens in the case of embryonic tissues, the object is lighter than the chloroform, it is not easy to tell when the saturation is complete, but generally on shaking the bottle a saturated tissue can be temporarily covered by the chlo-

roform, while tissues containing alcohol keep steadily on the surface.

When the tissue is saturated with the etherized cloroform it should be transferred to pure chloroform and there left for a few minutes. Then drop in some pellets of soft paraffine and leave it for two hours or more, shaking occasionally. The whole should then be poured into a small melting pot and a quantity of imbedding material added. The melting pot should then be placed in the water bath at a temperature of about 60° C., and there left until all the chloroform has evaporated, which may be determined by the absence of smell of chloroform on shaking. If much imbedding material is required this process takes a day or two; it is therefore better, when the solution of imbedding material is fairly strong, to take out the tissue and put it direct into pure melted imbedding material. In any case no chloroform must remain in the material to be cut, as it makes it brittle. Generally speaking the more gradually these processes are passed through the better will be the result.

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SCIENTIFIC NEWS.

— At a meeting of the Glasgow Philosophical Society in December, a paper was read by Professor W. Dittmar on the general results of his chemical work in connection with the Challenger expedition. Professor M'Kendrick commented on the paper, and said that the question of the breathing of marine animals was one of very great interest, and they could see at once that before it could be examined they must know something about the proportion of the gases dissolved in sea water. On that point they had been without accurate data up to the time of the very elaborate researches of which they had received an account that night. One fact which struck him as a physiologist as being most remarkable, was the very small quantity of oxygen in sea water, although it was yet sufficient for the respiration of fishes and other creatures living in the ocean. In point of fact blood was much richer in oxygen than sea water. It seemed to him that what they needed next was a careful analysis of the gases as they existed in the blood of fishes, more especially in that of some of those fishes which had been found at the depth of 2570 fathoms, living in a medium where the pressure on the square inch of the body must be something like three tons, because they had supposed that the problem of breathing depended to a considerable extent upon the law of pressures. It was well known that life could be maintained with a small quantity of oxygen in the event of carbonic acid being removed, and it was probable that in the case of those fishes, while the percentage of oxygen